

CVEN4201

Rock and Slope Engineering

Term 1, 2022



Course Overview

Staff Contact Details

Convenors

Name	Email	Availability	Location	Phone
Dr Kurt Douglas	k.douglas@unsw.edu.au	TBC in class	CE 506 or in my attic	9385 5046

School Contact Information

[Engineering Student Support Services](#) – The Nucleus - enrolment, progression checks, clash requests, course issues or program-related queries

[Engineering Industrial Training](#) – Industrial training questions

[UNSW Study Abroad](#) – study abroad student enquiries (for inbound students)

[UNSW Exchange](#) – student exchange enquiries (for inbound students)

[UNSW Future Students](#) – potential student enquiries e.g. admissions, fees, programs, credit transfer

Phone

(+61 2) 9385 8500 – Nucleus Student Hub

(+61 2) 9385 7661 – Engineering Industrial Training

(+61 2) 9385 3179 – UNSW Study Abroad and UNSW Exchange (for inbound students)

Course Details

Units of Credit 6

Summary of the Course

Description of rock mass and discontinuities; rock strength and failure criteria. Core logging; field data collection, mapping and fracture surveys; data presentation; hemispherical projections; introductory rock slope stability; foundations on rock; excavation on rock; in-situ stress; stresses about underground openings; classification systems and tunnel support requirements; site investigations for landslides and slope stabilisation techniques; use of slope stability analysis programs.

Course Aims

To teach you the basic principles related to the theory and design of rock engineering including methods for describing, recording and presenting features of rock masses.

To enable you to be able to perform basic designs in rock including foundations, slope stability and tunnel designs.

To study the basic principles related to the theory and design of rock and soil slopes including an examination of the different types of slope instability and different site investigation methods, methods of analysing slopes and different methods for stabilising slopes.

To give you some experience in using computer software to assess the stability of a slope and various remediation measures.

To give you a practical understanding of rock and slope engineering using examples and assignments.

Course Learning Outcomes

After successfully completing this course, you should be able to:

Learning Outcome	EA Stage 1 Competencies
1. Be familiar with the basic principles related to the theory and design of rock engineering including methods for describing, recording and presenting features of rock masses	PE1.1, PE1.3, PE1.4, PE2.1, PE2.4, PE3.2, PE3.4, PE3.6
2. To be able to perform basic designs in rock including foundations, slope stability and tunnel designs	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
3. Be familiar with the basic principles related to the theory and design of rock and soil slopes	PE1.1, PE1.2, PE1.3, PE1.5, PE2.1, PE2.2, PE2.3
4. Be familiar with site investigation and analysis methods for soil and rock slopes and different methods for stabilising them.	PE1.2, PE1.3, PE1.5, PE2.2, PE2.1, PE2.3
5. Be able to use the software package SlopeW to assess the stability of a slope and various remediation measures.	PE1.3, PE1.5, PE2.1, PE2.2, PE2.3, PE1.2
6. To have a practical understanding of rock and slope engineering using class examples and assignments.	PE1.6
7. Work effectively in a team	PE3.6

Teaching Strategies

Lectures: Formal lectures (online) will be presented to discuss the basic principles of rock and slope engineering. Lectures will vary from standard PowerPoint lectures to more hands on demonstrations of various engineering techniques. You are expected to attend all the lectures as they will greatly assist in understanding what is presented in the lecture notes. The lectures will also be a primary point of communication between the class and myself. Further communication will be via your student email and Moodle. It is very important that you frequently check your messages.

Demonstrations/workshops: The demonstrations/workshops (in-person) in this subject are used to teach you 'hands-on' rock description and classification; plotting of defect data and use of computer programs. They will also contain opportunities for you to work on example problems. You will be expected to be present and participate at all demonstrations/workshops, as they will contain material not covered in lectures. Workshops will have live video access for those residing outside of the Sydney Basin.

Fieldtrip: There will be no fieldtrip this year due to COVID. Instead, relevant real-world examples will be provided during lectures.

Assignment: Your first assignment (multi-parts) will be a group assignment. The assignment has been developed so that it covers all the aspects of rock engineering and therefore provides you with a good facility for learning the course content. The second assignment will teach you how to analyse a slope using a computer program similar to those used in industry. You may approach me for guidance when doing your assignments. This includes showing drafts of your work to me for comment prior to submission.

Private study: Your private study should include review and reflection of lecture material; workshop and assignment problems; accessing provided links and supplementary material on Moodle and generally taking notice of the characteristics of the geological environments that you travel through each day. For each hour of contact it is expected that you will put in at least 1.5 hours of private study

Additional Course Information

The course will consist of one online 3 hour lecture and a face-to-face (videoed) 2 hour workshop each week. The workshop may be replaced with a lecture in some weeks.

Up until now you have studied soil properties and geology and basic geotechnical design in soils in third year. Part of this course will teach you the basics of rock mechanics and introduce you to design techniques for rock masses. The other part of this course covers slope stability that will use your existing knowledge of soil mechanics and what you learnt about rock mechanics in the first part of this course. The geology you studied in earlier courses will be very important in this course for developing geotechnical models that can be used to develop good engineering designs.

The course begins by examining methods of describing, recording and presenting rock mass features. This will be followed by learning about methods for determining the engineering properties of rock masses. This initial work will then be used to perform basic foundation, slope stability and tunnel designs.

The second part of the course will begin by examining the different types of slope instability and how to characterise them followed by a discussion of different site investigation techniques. Methods of analysing slopes including the use of stability analysis programs will be learnt. Finally different methods

for stabilising slopes will be covered.

Assessment

The final grade for this course will normally be based on the sum of the scores from each of the assessment tasks. The Final Examination is worth 55% of the Final Mark if class work is included and 100% if class work is not included. The class work is worth 45% of the Final Mark if included. A mark of at least 40% in the final examination is required before the class work is included in the final mark. The formal exam scripts will not be returned. Students who perform poorly in the assessment tasks and workshops are recommended to discuss progress with the lecturer during the semester. Note: The lecturer reserves the right to adjust the final scores by scaling if agreed by the Head of School.

Assessment task	Weight	Due Date	Course Learning Outcomes Assessed
1. Rock Engineering	30%	In parts - See schedule	1, 2, 3, 4, 6, 7
2. Slope Stability	15%	01/04/2022 04:00 PM	3, 4, 5, 6
3. Final exam	55%	Formal UNSW Exam Period	1, 2, 3, 4

Assessment 1: Rock Engineering

Start date: Week 2

Due date: In parts - See schedule

This assignment will be carried out in groups of three or four and will cover the entire rock engineering component of the course including: hemispherical projections and a simple rock slope design, rock core logging, a foundation design and a tunnel design. It is important that you all contribute to each part of the assignment so that you can practice applying everything you are presented with in class.

Additional details

The assignment will assess: how well you develop your geotechnical model (if required); your ability to record, plot and synthesise information; your ability to perform appropriate calculations with appreciation of assumptions; and how well you assess your answer/s. Quality of presentation is also important.

Students in surveys in previous years have expressed the desire for ongoing feedback. To facilitate this, the assignment will be split into components with due dates distributed throughout the session. This will allow you to complete each part as it is taught in class (similar to a workshop) so as not to overload yourselves at the end of the session and to enable me to give you some marks/feedback prior to the end of the year. It is aimed to give feedback within two weeks of submission.

Late submissions will be penalised at the standard UNSW rate of 5% per day after the due time and date have expired, capped at five days (120 hours), after which a student cannot submit an assessment.

Assessment 2: Slope Stability

Start date: Week 4

Due date: 01/04/2022 04:00 PM

This assignment will cover the slope stability component of the course. It will assess your ability to analyse a slope using the program Slope/W and to consider and design possible remediation measures. Geotechnical engineers often use computers to design and analyse slopes so it is important that you learn how to use them properly and also very importantly learn their limitations. Quality of presentation is also important.

Additional details

Late submissions will be penalised at the standard UNSW rate of 5% per day after the due time and date have expired, capped at five days (120 hours), after which a student cannot submit an assessment.

Assessment 3: Final exam

Assessment length: 2 hours (plus 10 minutes reading and 20 minutes upload time)

Due date: Formal UNSW Exam Period

The final OPEN BOOK exam will assess your understanding of the whole course with particular emphasis on your ability to synthesise data and investigate and design structures in rock masses and slopes.

Attendance Requirements

Students are strongly encouraged to attend all classes and review lecture recordings.

Course Schedule

[View class timetable](#)

Timetable

Date	Type	Content
Week 1: 14 February - 18 February		Description of rock mass and discontinuities. Data collection and presentation. Core logging.
Week 2: 21 February - 25 February		Rock strength and failure criteria. Ass 1a out 24/2.
Week 3: 28 February - 4 March		Hemispherical projections, introductory rock slope stability. Ass 1a due 4/3. Ass 1b out 3/3.
Week 4: 7 March - 11 March		Site investigations for landslides. Slope stability analysis. Ass 2 out 10/3.
Week 5: 14 March - 18 March		Slope stabilisation techniques. Ass 1b due 18/3.
Week 6: 21 March - 25 March		Flexibility Week - No lecture/workshop.
Week 7: 28 March - 1 April		Foundations on rock. Ass 2 due 1/4. Ass 1c out 31/3.
	Assessment	Slope Stability
Week 8: 4 April - 8 April		In-situ stress. Stresses about underground openings. Ass 1d out 7/4.
Week 9: 11 April - 15 April		Classification systems and tunnel support requirements. Ass 1c due 15/4.
Week 10: 18 April - 22 April		Review. Ass 1d due 22/4.

Resources

Prescribed Resources

No compulsory texts. Students will be provided with notes and references to explore in Moodle and during class.

Recommended Resources

The following are recommended reading.

- Hoek, E. (2007) Practical Rock Engineering. FREE DOWNLOAD:
<https://www.rocsience.com/learning/hoek-s-corner>
- Brady, B.H.G. and Brown, E.T. (2006) Rock Mechanics for Underground Mining, 3rd Edition. [E-book Available Online through library]
- Wyllie, D.C. and Ma, C.W. (2004) Rock Slope Engineering, 4th Edition. Spon Press:New York. [Note: continues Hoek, E. and Bray, E.W. (1981) Rock Slope Engineering, 3rd Edition. The Institute of Mining and Metallurgy, London.] [E-book Available Online through library]
- Hoek E. and Brown E.T. (1982) Underground Excavation in Rock, The Institution of Mining and Metallurgy, London.
- Hoek, E., Kaiser, P.K. and Bawden, W.F. (1995) Support of Underground Excavations in Hard Rock.
- Hudson, J.A. and Harrison, J.P. (2005) Engineering Rock Mechanics. 3rd Impression. Permagon. [E-book Available Online through library]
- Bell, F.G. (2007) Engineering Geology. Burlington : Elsevier. [E-book Available Online through library]

Websites of interest include:

- Australian Geomechanics Society: <https://australiangeomechanics.org/>
- Australian Geomechanics Society, Sydney:
<https://australiangeomechanics.org/chapter/sydney-nsw/>
- Int. Soc. for Soil Mechanics & Geotechnical Engineering: <https://www.issmge.org/>
- International Society for Rock Mechanics: <https://www.isrm.net/>
- International Association of Engineering Geology: <https://www.iaeg.info/>
- The Australasian Institute of Mining and Metallurgy: <https://ausimm.com/>
- The U.S. Geological Survey: <https://www.usgs.gov/>
- Science Direct Journal Search: <https://www.sciencedirect.com/>

More will be provided on Moodle as required.

iPhone (and other almost as smart phones)

There are numerous apps being developed for various smart phones. At the moment, there are only a handful developed for geology/geotechnical work that are free. One that may be useful for this course is:

- GeoID– works as a geological compass that can be used for basic rock mapping. It also allows for real-time plotting on a Schmidt Net or similar (useful to check your assignment).

Computer Software

The School computer laboratories provide you access to *Rocscience* programs, *Dips* (plotting defect data) and *Examine* and *RS2* (underground stress analysis); and the *GeoStudio* program *GeoSlope* (soil slope stability analysis). Software can also be accessed via *Access Anytime Anywhere* (TIP: Using the virtual machine option is usually faster). For example for *Rocscience* software:
<https://www.myaccess.unsw.edu.au/applications/rocscience-suit>

Course Evaluation and Development

The course is reviewed annually through the myExperience survey. All responses are considered and I make changes to the course annually in response. I am also always happy to get feedback during the course for immediate consideration. You can email me directly or use the feedback discussion tool I have placed in Moodle.

I am aware from feedback that there is a lot of content in our course. You do not have to read and watch everything you are provided with, it is there if you need it or want to explore further. It is much like solving problems in industry, where you are required to identify the information you need to solve and delve deeply into the literature where required.

Submission of Assessment Tasks

Please refer to the Moodle page of the course for further guidance on assessment submission.

UNSW has a standard late submission penalty of:

- 5% per day, for all assessments where a penalty applies, capped at five days (120 hours), after which a student cannot submit an assessment, and no permitted variation.

Academic Honesty and Plagiarism

Beware! An assignment that includes plagiarised material will receive a 0% Fail, and students who plagiarise may fail the course. Students who plagiarise are also liable to disciplinary action, including exclusion from enrolment.

Plagiarism is the use of another person's work or ideas as if they were your own. When it is necessary or desirable to use other people's material you should adequately acknowledge whose words or ideas they are and where you found them (giving the complete reference details, including page number(s)). The Learning Centre provides further information on what constitutes Plagiarism at:

<https://student.unsw.edu.au/plagiarism>

Academic Information

Final Examinations:

Final exams in T1 2022 will be held online between 29th April - 12th May inclusive, and supplementary exams between 23rd - 27th May inclusive. You are required to be available on these dates. Please do not to make any personal or travel arrangements during this period.

ACADEMIC ADVICE

- Key Staff to Contact for Academic Advice (log in with your zID and password): <https://intranet.civeng.unsw.edu.au/key-staff-to-contact-during-your-studies-at-unsw>
- [Key UNSW Dates](#) - eg. Census Date, exam dates, last day to drop a course without academic/financial liability etc.
- CVEN Student Intranet (log in with your zID and password): <https://intranet.civeng.unsw.edu.au/student-intranet>
- Student Life at CVEN, including Student Societies: <https://www.unsw.edu.au/engineering/civil-and-environmental-engineering/student-life>
- Special Consideration: <https://student.unsw.edu.au/special-consideration>
- General and Program-Specific Questions: [The Nucleus: Student Hub](#)
- Refer to Academic Advice on the School website available at: <https://www.engineering.unsw.edu.au/civil-engineering/student-resources/policies-procedures-and-forms/academic-advice>

Image Credit

Dr Kurt Douglas

CRICOS

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Acknowledgement of Country

We acknowledge the Bedegal people who are the traditional custodians of the lands on which UNSW Kensington campus is located.

Appendix: Engineers Australia (EA) Professional Engineer Competency Standard

Program Intended Learning Outcomes	
Knowledge and skill base	
PE1.1 Comprehensive, theory based understanding of the underpinning natural and physical sciences and the engineering fundamentals applicable to the engineering discipline	✓
PE1.2 Conceptual understanding of the mathematics, numerical analysis, statistics, and computer and information sciences which underpin the engineering discipline	✓
PE1.3 In-depth understanding of specialist bodies of knowledge within the engineering discipline	✓
PE1.4 Discernment of knowledge development and research directions within the engineering discipline	✓
PE1.5 Knowledge of engineering design practice and contextual factors impacting the engineering discipline	✓
PE1.6 Understanding of the scope, principles, norms, accountabilities and bounds of sustainable engineering practice in the specific discipline	✓
Engineering application ability	
PE2.1 Application of established engineering methods to complex engineering problem solving	✓
PE2.2 Fluent application of engineering techniques, tools and resources	✓
PE2.3 Application of systematic engineering synthesis and design processes	✓
PE2.4 Application of systematic approaches to the conduct and management of engineering projects	✓
Professional and personal attributes	
PE3.1 Ethical conduct and professional accountability	
PE3.2 Effective oral and written communication in professional and lay domains	✓
PE3.3 Creative, innovative and pro-active demeanour	
PE3.4 Professional use and management of information	✓
PE3.5 Orderly management of self, and professional conduct	
PE3.6 Effective team membership and team leadership	✓